# CORRUGATED PLATELET FEED ARRAYS FOR MILLIMETER WAVE IMAGING

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Millimeter and submillimeter wave imaging systems for radio astronomy and remote sensing require high efficiency coupling structures. The realization of such antenna elements in large focal plane arrays can potentially enable reductions in observing time and improvements in calibration accuracy while maintaining desirable imaging properties. Low-loss transitions from free-space to high performance sensors require a conversion in the impedance level, electromagnetic modal symmetry, and the detectors thermal environment, while achieving the desired image sampling and maintaining the radiometers angular, polarization, and frequency selectivity. The conical corrugated horn is a commonly used element due to its symmetrical (scalar) Gaussian beam, low-side lobe levels, and cross-polarization response. These properties are achieved over a large fractional bandwidth by transitioning from the dominant $TE_{11}$ mode in circular waveguide with half-wavelength slots to quarter-wavelength slots in order to produce $HE_{11}$ illumination at the aperature.

The conventional technique for manufacturing a corrugated feed in the high frequency limit is by precision electro-forming on a non-reusable machined mandrel which is subsequently removed by chemical etching. We investigate means of fabricating large arrays for these structures by sandwiching precision chemical-milled thin metal sheets which are then mechanically bonded. To explore the feasibility of this approach and the achievable tolerances, we have manufactured and characterized a pair of $\sim$ 1000 element arrays with input guide cutoff and hybrid frequencies of 264 and 391 GHz respectively. Our alignment design rules are guided by the observation that tolerances relative to wavelength more critical than absolute placement for this class of adiabatic structures.

Post-fabrication mechanical and electrical survey of a subset of array elements indicates that this goal was maintained across this $\sim$ 1mm waveband array. The match for feed elements was observed to be better than 20dB with a vector network analyzer outfitted with millimeter wave heads. The measured co- and cross-polar response for elements are uniform and in agreement with the theoretical performance computed from the feed geometry (E and H-planes FWHM are 28.4 and 28.0 degrees respectively). To explore the potential influences of the various bonding processes on the transmission efficiency, diffusion welded and thin film epoxy laminate platelet waveguide samples in WR28.0, WR10.0 and WR5.1 were fabricated, characterized and sectioned. The observed loss was observed to be within a factor of two of the theoretical estimate computed from the bulk metal resistivity. We conclude that it is feasible to realize arrays with this construction up to $\sim$ 1THz.

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